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<u>L8</u>	L7 not l6	2040	<u>L8</u>
<u>L7</u>	(l2 or l3) and (sio2 or silica or silicon)	2081	<u>L7</u>
<u>L6</u>	L5 and (sio2 or silica or silicon)	41	<u>L6</u>
<u>L5</u>	(l2 or l3) and beta	121	<u>L5</u>
<u>L4</u>	beta with cristobalite or beta\$1cristobalite	28	<u>L4</u>
<u>L3</u>	al\$si\$po4 or alpo4	377	<u>L3</u>
<u>L2</u>	(aluminum or al) with (po4 or \$phosphate)	9739	<u>L2</u>
<u>L1</u>	wo-9200929-\$.did.	2	<u>L1</u>

END OF SEARCH HISTORY

**TABLE 4.6** Atom Radii and Effective Ionic Radii of Elements

Element	Atom radius, pm	Effective ionic radii, pm				
		Ion charge	Coordination number			
			4	6	8	12
Actinium	187.8	3+		111		
Aluminum	143.1	3+	39	53.5		
Americium	173	2+			126	
		3+		97.5	109	
		4+		89	95	
		5+		86		
		6+		80		
		3-		245		
Antimony	145	1+		89		
		3+	76	76		
		5+		60		
		3-		222		
Arsenic	124.8	3+		58		
		5+	33.5	46		
		1-		227		
Astatine		5+		57		
		7+		62		
		2+		136	142	160
Barium	217.3	2+		118		
Berkelium		3+		98		
		4+		87	93	
		1-	195			
Beryllium	111.3	2+	27	45		
Bismuth	154.7	3-		213		
		3+		103	111	
		5+		76		
		1+	35			
Boron	86	3+	11	27		
		1-		196		
Bromine		3+	59			
		5+	31*	47		
		7+		25		
		2+	78	95	110	131
Cadmium	148.9	2+		100	112	135
Calcium	197	2+		117		
Californium	186(2)	3+		95		
		4+		82.1		
		4-	260			
		4+	15	16		
Carbon		3+		102	114.3	134
		4+		87	97	114
Cesium	265	1+		167	174	188
Chlorine		1-		181		
		5+	34			
		7+	8	27		
		1+	81			
Chromium	128	2+		73 LS 80 HS		
		3+		61.5		

\* CN = 3

**TABLE 4.6** Atom Radii and Effective Ionic Radii of Elements (*Continued*)

Element	Atom radius, pm	Effective ionic radii, pm				
		Ion charge	Coordination number			
			4	6	8	12
Chromium ( <i>continued</i> )		4+	41	55		
		5+	34.5	49	57	
		6+	26	44		
Cobalt	125	2+	38	65 LS 74.5 HS	90	
		3+		54.5 LS 61 HS		
		4+	40	53 HS		
Copper	128	1+	60	77		
		2+	57	73		
		3+		54 LS		
Curium	174	3+		97		
		4+		85	95	
Dysprosium	178.1	2+		107	119	
		3+		91.2	102.7	
Einsteinium	186(2)	3+		98		
Erbium	176.1	3+		89.0	100.4	
Europium	208.4	2+		117	125	135
		3+		94.7	106.6	
Fluorine	71.7	1-	131	133		
		7+		8		
Francium	270	1+		180		
Gadolinium	180.4	3+		93.8	105.3	
Gallium	135	2+		120		
		3+	47	62.0		
Germanium	128	2+		73		
		4+	39.0	53.0		
Gold	144	1+		137		
		3+	68	85		
Hafnium	159	4+	58	71	83	
Holmium	176.2	3+		90.1	101.5*	112
Hydrogen		1-		154		
Indium	167	1+		140		
		3+	62	80.0	92	
Iodine		1-		220		
		5+		95		
		7+	42	53		
Iridium	135.5	3+		68		
		4+		62.5		
		5+		57		
Iron	126	2+		61 LS		
			63 HS	78 HS	92 HS	
		3+		55 LS		
			49 HS	64.5 HS	78 HS	
		4+		58.5		
		6+	25			
Lanthanum	183	3+		103.2	116.0	136

\* CN = 10

**TABLE 4.6** Atom Radii and Effective Ionic Radii of Elements (*Continued*)

Element	Atom radius, pm	Effective ionic radii, pm				
		Ion charge	Coordination number			
			4	6	8	12
Lead	175	2+	98	119	129	149
		4+		78	94	
Lithium	152	1+	59	76		
Lutetium	173.8	3+		86.1	97.7	
Magnesium	160	2+	57	72.0	89	
Manganese	127	2+	66 HS	67 LS	96	
				83 HS		
		3+		58 LS		
				64.5 HS		
		4+	39	53		
		5+	33			
		6+	25.5			
		7+	25	46		
Mercury	151	1+	111*	119		
		2+	96	102	114	
Molybdenum	139	3+		69		
		4+		65.0		
		5+	46	61		
		6+	41	59	73†	
Neodymium	181.4	2+			129	
		3+		98.3	110.9	127
Neptunium	155	2+		110		
		3+		101		
		4+		87	98	
		5+		75		
		6+		72		
		7+		71		
Nickel	124	2+	55	69.0		
		3+		56 LS		
				60 HS		
		4+		48 LS		
Niobium	146	3+		72		
		4+		68	79	
		5+	48	64	74	
Nitrogen		3-	146			
		1+	25			
		3+		16		
		5+		13		
Nobelium		2+		110		
Osmium	135	4+		63.0		
		5+		57.5		
		6+		54.5		
		7+		52.5		
		8+	39			
Oxygen		2-	138	140	142	
Palladium	137	2+	64	86		
		3+		76		
		4+		61.5		

\* CN = 3

† CN = 7

**TABLE 4.6** Atom Radii and Effective Ionic Radii of Elements (*Continued*)

Element	Atom radius, pm	Effective ionic radii, pm				
		Ion charge	Coordination number			
			4	6	8	12
Phosphorus	108	3−		212		
		3+		44		
		5+	17	38		
Platinum	138.5	2+		80		
		4+		62.5		
		5+		57		
Plutonium	159	3+		100		
		4+		86	96	
		5+		74		
		6+		71		
Polonium	164	2−		(230)		
		4+		94	108	
		6+		67		
Potassium	232	1+	137	138	151	164
Praseodymium	182.4	3+		99	112.6	
		4+		85	96	
Promethium	183.4	3+		97	109.3	
Protoactinium	163	3+		104		
		4+		90	101	
		5+		78	91	
Radium	(220)	2+			148	170
Rhenium	137	4+		63		
		5+		58		
		6+		55		
		7+	38	53		
Rhodium	134	3+		66.5		
		4+		60		
		5+		55		
Rubidium	248	1+		152	161	172
Ruthenium	134	3+		68		
		4+		62.0		
		5+		56.5		
		7+	38			
		8+	36			
Samarium	180.4	2+			127	
		3+		95.8	107.9	124
Scandium	162	3+		74.5	87.0	
Selenium	116	2−		198		
		4+		50		
		6+		42		
Silicon	118	4+	26	40.0		
Silver	144	1+	100	115	130	
		2+	79	94		
		3+	67	75		
Sodium	186	1+	99	102	118	139
Strontium	215	2+		118	126	144
Sulfur	106	2−		184		
		4+		37		
		6+	12	29		
Tantalum	146	3+		72		

**TABLE 4.6** Atom Radii and Effective Ionic Radii of Elements (*Continued*)

Element	Atom radius, pm	Effective ionic radii, pm				
		Ion charge	Coordination number			
			4	6	8	12
Tantalum		4+		68		
(continued)		5+		64	74	
Technetium	136	4+		64.5		
		5+		60		
		7+	37	56		
Tellurium	142	2-		221		
		4+	66	97		
		6+	43	56		
Terbium	177.3	3+		92.3	104.0	
		4+		76	88	
Thallium	170	1+		150	159	170
		3+	75	88.5	98	
Thorium	179	4+		94	105	121
Thulium	175.9	2+		103		
		3+		88.0	99.4	105*
Tin	151	2+		118		
		4+	55	69.0	81	
Titanium	147	2+		86		
		3+		67.0		
		4+	42	60.5	74	
Tungsten	139	4+		66		
		5+		62		
		6+	42	60		
Uranium	156	3+		102.5		
		4+		89	100	117
		5+		76		
		6+	52	73	86	
Vanadium	134	2+		79		
		3+		64.0		
		4+		58	72	
		5+	35.5	54		
Xenon		8+	40	48		
Ytterbium	193.3	2+		102	114	
		3+		86.8	98.5	104*
Yttrium	180	3+		90.0	101.9	108*
Zinc	134	2+	60	74.0	90	
Zirconium	160	4+	59	72	84	89*

\* CN = 11

**4.5.2 Ionic Radii**

One of the major factors in determining the structures of the substances that can be thought of as made up of cations and anions packed together is ionic size. It is obvious from the nature of wave functions that no ion has a precisely defined radius. However, with the insight afforded by electron